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Since

$$e' = \frac{\sqrt{b^2 - b'^2}}{b}$$

and

$$b' = \sqrt{y^2 + z^2} = \sqrt{b^2 \cos^2 \theta + a^2 \sin^2 \theta},$$

$$e' = \frac{\sqrt{b^2 - b'^2 \cos^2 \theta - a^2 \sin^2 \theta}}{b} = \frac{\sqrt{(b^2 - a^2)(1 - \cos^2 \theta)}}{b} = e \sin \theta.$$

But $z/y = \tan i = (a/b) \tan \theta$, or $\tan \theta = (b/a) \tan i$. Therefore,

$$\sin \theta = \frac{b \tan i}{\sqrt{a^2 + b^2 \tan^2 i}} = \frac{b \tan i}{\sqrt{b^2 - b^2 e^2 + b^2 \tan^2 i}} = \frac{\tan i}{\sqrt{\sec^2 i - e^2}}.$$

Substituting for $\sin \theta$, we have

$$e' = \frac{e \tan i}{\sqrt{\sec^2 i - e^2}}.$$

Also solved by ROGER A. JOHNSON, ELBERT H. CLARKE, H. L. OLSON, and the PROPOSER.

2674. Proposed by J. O. MAHONEY, Dallas, Texas.

If two sides of a triangle differ by less than a certain length, e , the two opposite angles will differ by less than a certain quantity λ , expressed in degrees, such that $\lambda < 61e/a$ where a expresses, with a possible error e , the length of the apparently equal sides of the triangle.

SOLUTION BY ROGER A. JOHNSON, Hamline University.

This theorem as stated, is not true. Consider, for instance, the triangle

$$a = 1001, \quad b = 1000, \quad c = 99.$$

Here,

$$A = 87^\circ 44' 32'', \quad B = 86^\circ 35' 10'', \quad C = 5^\circ 40' 18''.$$

Now, considering the nearly equal angles A and B , we have, in fact, $\lambda = 1.157$, whereas by the formula given, we should have $\lambda = .061$ or less. This is an extreme case, but it will be found that in any triangle in which the nearly equal angles are greater than about 50° , the formula does not hold.

As a matter of fact, the correct expression is

$$\lambda = \frac{180}{\pi} \frac{e}{a} \tan A,$$

where A represents the larger of the nearly equal angles. We will not consider the case that either of these two angles exceeds or equals 90° .

If a and b are two sides of a triangle, α , β , the opposite angles, we have

$$\sin \beta = \frac{\sin \alpha}{a} \cdot b;$$

whence

$$\cos \beta d\beta = \frac{\sin \alpha}{a} db,$$

in radians, or

$$d\beta = \frac{180^\circ}{\pi} \cdot \frac{\sin \alpha}{\cos \beta} \frac{db}{a}$$

For our problem, $d\beta = \lambda$, $db = e$, and $(\sin \alpha)/(\cos \beta)$ may be replaced by the greater of the values $\tan \alpha$, $\tan \beta$, yielding the inequality given above.

Also solved by ELIJAH SWIFT and PAUL CAPRON.

2675. Proposed by E. B. ESCOTT, Kansas City, Mo.